AN EVALUATION OF TWO TOMATO CULTIVARS TO INFESTATION BY CERTAIN INSECT PESTS

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ABSTRACT

Field experiments were carried out to investigate the seasonal abundance and population dynamics of certain tomato pests viz.; tomato whitefly, *Bemisia tabaci* (Gennadius), aphids (cotton aphid, *Aphis gossypii* Glover and green peach aphid, *Myzus persicae* Sülzer), potato leafhopper, *Empoasca decipiens* Paoli and tomato leafminer, *Tuta absoluta* (Meyrick) and evaluate the susceptibility of two tomato cultivars (Hybrid Super Strain BF_1 and Super Crystal HYB) to the infestation with these pests as a major component of the integrated pest management in clean and organic agriculture that rationalize the unwise use of pesticides and accordingly producing safe food. Obtained results revealed that *B. tabaci* had 2-3 peaks of abundance during summer seasons 2012 & 2013 on both cultivars. Aphids and *E. decipiens* had 1-2 peaks each season. On the other hand, *T. absoluta* had only one peak during both seasons. Data also revealed the presence of negative and highly significant correlation between the population densities of all investigated pests and the numbers of non-glandular hairs on tomato leaves. The effect of nitrogen and calcium on all investigated pests was positive and highly significant; while the effect of potassium was negative and highly significant. The effect of phosphorus was positive and highly significant on all sap sucking pests on the cultivar Crystal HYB; while magnesium had positive and highly significant effect on the investigated pests on the cultivar Hybrid Super. The effect of iron, zinc and manganese was positive and highly significant and cupper was negatively affected these pests on both cultivars.

Keywords: *Bemisia tabaci*, *Aphis gossypii*, *Empoasca decipiens*, *Tuta absoluta,* seasonal abundance, susceptibility, trichomes, nutrients.

INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is one of the most popular vegetable crops in the world (Mukhtar et al., 2009). Mainly grown for human consumption, in 2012, the total area grown with tomatoes in the world was about 11.2 million feddans and the total world production was 161,793,834 tons. Egypt is ranked as the fifth country in the world in terms of total production of tomatoes. The cultivated area reached 591,384 feddans produced 8,625,219 tons (Food and Agriculture Organization Statistics, 2014).

Tomato plants and fruits are attacked by many insect pests and diseases either in the field or in storage. The most important insect pests include the mole-cricket, *Gryllotalpa gryllotalpa* (L.); the white grubs, *Pentodon bispinosus* (Küster); the black cutworm, *Agrotis ipsilon* (Hufnagel); cotton leafworm, *Spodoptera littoralis* (Boisduval); tomato whitefly, *Bemisia tabaci* (Gennadius); aphids {cotton aphid, *Aphis gossypii* (Glover) and green peach aphid, *Myzus persicae* (Sülzer)}; Green stink bug, *Nezara viridula* (L.); potato leaf hopper, *Empoasca decipiens* (Poali); American tomato budworm, *Helicoverpa armigera* (Hübner); potato tuberworm, *Phthorimaea operculella* (Zeller) and tomato leafminer, *Tuta absoluta* (Merick). The ecology of these pests was studied by Arnal et al., 1993; Adam et al., 1997; Bezerra et al., 2004; Garzia et al., 2009; Setiawati et al., 2009; Summers et al., 2010; Chakraborty, 2011; Hrncic and Radoniic 2011; Allache and Demnati, 2012 and Spasov et al., 2013. The susceptibility of different cultivars was also studied by Leite et al., 1999; Abdallah et al., 2001; Leite et al., 2004; Marcos et al., 2005; Sahu and Shaw, 2005; Ashfaq et al., 2012; Snyder and Min, 2012 and Han et al., 2014. Plant breeding is a major component in pest control in clean and organic production of foods for safe consumption. The selection of cultivars or traits that contain certain chemical (including macro- and micro-nutrients) or physical (including different types of trichomes, presence of volatiles and thickness of lamella) properties that fight against insect pest infestation is very important in constructing an integrated pest management program. Glandular trichomes have been shown to significantly reduce the level of infestation of homopteran pests, particularly aphids and leafhoppers, on a variety of agronomically significant crops such as tomato (Gofferda et al. 1988, 1989) and potato (Tingey and Laubengayer 1981, 1986; LaPointe and Tingey 1984, 1986).The present investigation was conducted to follow up the seasonal fluctuations in the population densities of *B. tabaci*, aphids, *E. decipiens* and *T. absoluta* on tomato plants and evaluate the susceptibility of two grown cultivars to the infestation with these pests.

MATERIAL AND METHODS

Field experiments were carried out at the experimental farm attached to the Faculty of Agriculture, Ain Shams University at Shalakan, Qalyubyia Governorate. An area of about 0.25 feddan was cultivated with each one of the two tested tomato cultivars in spring-summer plantations 2012 and 2013 (Hybrid Super Strain BF_1 and Super Crystal HYB). Transplanting dates were 4 April, 2012 and 24 March, 2013. The agricultural practices were carried out as usual. The seasonal abundance and population dynamics of tomato pests viz.; tomato whitefly, *Bemisia tabaci* (Gennadius), aphids (cotton aphid, *Aphis gossypii* Glover and green peach aphid, *Myzus persicae* Sülzer), potato leafhopper, *Empoasca decipiens* Paoli and tomato leafminer, *Tuta absoluta* were studied.

1. Population dynamics of tomato insect pests

The seasonal abundance of different stages of *B. tabaci*, (adults, nymphs and eggs) were counted on 20 leaflets, replicated three times (a total of 60 leaflets/ sampling date). During the first plantation, sampling period extended from 8 May to 10 July, 2012 (10 inspections). In the second plantation, this period extended from 23 April to 2 July, 2013 (11 inspections). This procedure was carried out for each tested tomato cultivar. Counts of aphids and leafhoppers (adults and nymphs) were carried out at the same way. For *T. absoluta*, numbers of eggs, larvae and mines were counted. The total number for each insect pest was used to represent its population dynamics.

2. Susceptibility of two tomato cultivars to insect pest infestation

2.1. Anatomical studies

Anatomical studies were carried out where leaf samples were picked up from the upper part of the plant from the two tested cultivars at three sampling dates, 12 May; 4 June and 20 June, 2013. Samples were killed and fixed in FAA using the method of Jonhnsen (1940), dehydrated with ascending serial concentrations of ethyl alcohol and serial transverse sections (20µ each) were prepared using the standard paraffin technique. All sections were fixed in small glass slides (1x2 cm) by means of Haupt's adhesive. Finally, specimens were sputter coated with gold coat after removing wax. To study the number and length of trichomes (hairs) on both sides of the leaves, specimens (0.2x0.8 mm) were killed and fixed in glutaraldehyde 2.5% for 24h at 4°C, then post-fixed in osmium tetroxide (O_sO_4) 1% for one hour at room temperature (Millonig, 1961), dehydrated with ascending serial concentrations of acetone. Samples were critical point dried and coated with gold. All observations, measurements and photography were done through a Joel Scanning Electron Microscope (SEM) (T. 330A) at 30 Kv. at the Unit of Electron Microscopy, Central Laboratory Unit, Faculty of Agriculture, Ain Shams University.

2.2. Macro- and micro nutrients

Leaf samples from the two tested tomato cultivars were taken for nutritional studies at the same dates mentioned above. Leaves were dried at 70°C, weighted and digested using a mixture of sulfuric acid with hydrogen peroxide according to the method described by FAO (1989). Wet digestion was performed through using 0.5 g from oven-dry leaves material and then added in 50 ml conical flask and digested with 10 ml of H_2SO_4 on a hot plate at approximately 270°C. Small quantities of H_2O_2 were added repeatedly until the digested solution became clear. The solution was left to cool and then diluted to 50 ml with redistilled water in a volumetric flask.

In the acid digested solution, the micronutrients determined were iron (Fe), zinc (Zn), calcium, (Ca), Magnesium (Mg), manganese (Mn) and cupper (Cu) using atomic absorption spectrophotometer; while phosphorus (P) concentration in acid digested samples was determined by colorimetric method (ammonium molybdate) using spectrophotometer. Total nitrogen (N) content was determined using microkjeldahle method, whereas potassium (K) content was detected using the flame photometer (Chapman and Pratt, 1982). All nutritional studies were conducted at the Arid Land Agricultural Research Institute, Faculty of Agriculture, Ain Shams University.

RESULTS AND DISCUSSION

1. Population dynamics of certain tomato insect pests on two tomato cultivars during summer plantations

1.1. *Bemisia tabaci* (Gennadius)

Data in Table 1 show the fluctuations in the population densities of the four investigated tomato pests on two cultivars of tomato during summer plantation of 2012. These data indicate that on the cultivar Hybrid Super, the population of *B. tabaci* had two peaks of abundance during that season; the first was during the second week of May (1227 individuals/60 leaflets) compared to 405 individuals in the second peak at the second week of June.

A gradual decrease in the population density occurred till the end of the season. On the cultivar Crystal HYB, the total population of *B. tabaci* was less than that on Hybrid Super and also had two peaks of abundance; the first was during the second half of May (807 individuals) and the second was one month later (388 individuals). The differences between the two cultivars in their infestation were insignificant (t = 2.02).

Table 1: The total numbers of certain tomato insect pests on two cultivars of tomato during summer plantation (2012), Shalakan, Qalyubyia Governorate

Sampling Date	Planting date 4-4-2012							
	Hybrid Super cultivar				Crystal H Y B cultivar			
	B. tabaci	Aphids	*E. decipiens*	*T. absoluta*	*B. tabaci*	Aphids	*E. decipiens*	*T. absoluta*
08/5	1227	330	21	19	794	477	19	25
15/5	930	122	95	57	807	110	89	31
22/5	805	42	68	57	692	9	31	19
29/5	507	7	57	80	530	3	70	72
05/6	391	9	12	27	263	5	9	27
12/6	405	12	14	33	388	15	17	23
19/6	213	1	23	15	167	0	23	9
26/6	115	0	2	3	86	1	0	6
03/7	33	0	0	2	41	0	0	4
10/7	3	0	0	1	3	0	0	1
Total	4629	523	292	294	3771	620	258	217
't' value	2.02	0.61	0.84	1.73				

Data in Table 2 clearly indicate that the population of *B. tabaci* during 2013 plantation was higher than that of summer 2012. On the cultivar Hybrid Super, the total population reached 6286 individuals with three peaks of abundance. The first peak occurred during the last week of April, 2013 being 1803 individuals. The second occurred during the second week of May, 2013 (946 individuals); while the third peak was during the first week of June (318 individuals). On the cultivar Crystal HYB, the population of *B. tabaci* was much lower (3673 individuals) than that on Hybrid and also had three peaks of abundance; the first was during the last week of April, 2013 with a total of 1045 individuals/60 leaflets. The second peak was reached two weeks later with a total of 603 individuals; while the third was during the first week of June being 226 individuals. The differences between the two cultivars in their infestation were significant (t = 2.20*).

1.2. Aphids, *Aphis gossypii* (Glover) and *Myzus persicae* (Sülzer)

Regarding the population size of both two aphid species occurred on the two tested cultivars, the case was on the contrary of that of *B. tabaci* since the cultivar Hybrid Super harbored a relatively lower population than Crystal HYB during 2012 summer season (t = 0.61; Table 1). Two peaks of abundance were observed on each cultivar during the second week of May and one month later. During 2013 season, the same trend was observed and although the differences between the population densities on the two cultivars were higher but it was insignificant (t = 1.02; Table 2). Only one peak was observed on each cultivar at the beginning of the season (last week of April).

Table 2: The total numbers of certain tomato insect pests on two cultivars of tomato during summer plantation (2013), Shalakan, Qalyubyia Governorate

Sampling Date	Planting date 24-3-2013							
	Hybrid Super cultivar				Crystal H Y B cultivar			
	B. tabaci	Aphids	*E. decipiens*	*T. absoluta*	*B. tabaci*	Aphids	*E. decipiens*	*T. absoluta*
23/4	1295	641	18	4	691	1006	8	6
30/4	1803	180	21	31	1045	227	30	31
07/5	903	53	47	66	495	51	63	46
14/5	946	35	74	47	603	12	28	26
21/5	399	0	3	23	191	0	3	13
28/5	212	0	4	12	217	0	4	10
04/6	318	0	2	8	226	0	0	0
11/6	211	0	0	18	110	0	0	9
18/6	110	0	0	5	94	0	0	7
25/6	76	0	0	0	45	0	0	0
02/7	13	0	0	0	19	0	0	2
Total	6286	909	169	214	3736	1296	136	150
't' value	2.2*	1.06	0.64	2.26*				

1.3. Potato leafhopper, *Empoasca decipiens* Poali

The population of *E. decipiens* in 2012 season was higher than that of 2013. During 2012 season, the population had two peaks of abundance on both cultivars; the first was during the second week of May and the second was during the third week of June. These peaks reached 95 and 23 individuals/60 leaflets on Hybrid Super and 89 and 23 individuals /60 leaflets on Crystal HYB. The differences between the total populations on both cultivars were insignificant; t = 0.84 (Table 1). In the second season (2013), the population of *E. decipiens* was much lower than aphids on both cultivars and it had only one peak on the second week of May (74 individuals/60 leaflets) on Hybrid Super and 63 individuals on Crystal HYB. The differences between the populations on both cultivars were insignificant; t = 0.64 (Table 2).

1.4. Tomato leafminer, *Tuta absoluta* (Meyrick)

Data in Tables 1 & 2 reveal that the two tested cultivars almost harbored the same population density of the immature stages of *T. absoluta* during summer season 2012. The differences in the population density were insignificant (t = 1.73). The pest had only one peak during the last week of May in 2012 being 80 and 72 individuals/60 leaflets on Hybrid Super and Crystal HYB, respectively. This peak occurred on the first week of May in 2013 being 66 and 46 individuals on both cultivars, respectively. The differences in the population density were insignificant (t = 2.26*).

Most authors in the literature had results that not in full harmony with our results. Arno et al. (2005), Wenfeng et al. (2009) and Karut et al. (2012) reported that *B. tabaci* was more abundant in autumn than in spring and its populations were strongly reduced during winter. These results agreed with those found by Herakly (1974) in Egypt who found that *Myzus persicae* and *Aphis gossypii* infested tomato plants was found to be higher in late summer season. Dawood (1999) recorded one population peak of *A. gossypii* on the 18 and 21 May during two seasons on the five tomato cultivars. Abdallah et al. (2000) reported that *M. persicae* was detected during summer plantation of 1995 on potato plants in reliable numbers on the 4th week of April when plants were 7 weeks old. In 1996, this peak took place one week earlier. Similar results were found by Vuong et al. (2001); Ebadah (2002) and Der et al. (2003).These data are also in harmony with those found by Oliveira et al. (2008) in Brazil; Cota (2011); Nannini et al. (2011), Hrncic and Radoniic (2011) and Allache and Demnati (2012) in Algeria.

2. Relationship between the numbers of hairs on tomato leaves and population densities of the considered pests

Data in Table 3 show the correlation between the number of hairs (at different magnification powers of SEM) in the cultivar Hybrid sown during summer 2013 and the population densities of certain tomato pests. These data reveal the presence of negative and highly significant correlation between the population densities of all considered pests and the numbers of hairs during the first sampling date (20 May). The correlation coefficient values were the same during the second sampling date (4 June) except for aphids which disappeared during hot summer months. In the third sampling date (20 June), the correlation was also negative and highly significant with the population of *B. tabaci* and positive with the population of *T. absoluta*. On the cultivar Crystal (Table 4), the correlation was also negative and highly significant between *B. tabaci* populations and the numbers of hairs during the three sampling dates; while the correlation with *T. absoluta* was positive and insignificant.

Table 3: The correlation coefficient values for the relationship between the population densities of the examined insect pests and number of hairs on tomato leaflets (cultivar Hybrid) during spring-summer plantation of 2013

Pest	**Population density**	**Average no. of hairs/10 mm^2 at magnification of**		
		150X	**200X**	**500X**
		First Sampling Date (12/5/2013)		
No. of hairs		(500)	(500)	(150)
Bemisia tabaci	946	-0.9780	-0.7502	-0.8457
Aphids	35	-0.7890	-0.9875	-0.7882
E. decipiens	74	-0.8894	-0.7928	-0.9171
Tuta absoluta	47	-0.9632	-0.9338	-0.8817
		Second Sampling Date (4/6/2013)		
No. of hairs		(600)	(450)	(150)
Bemisia tabaci	318	-0.9632	-0.9781	-0.9359
Aphids	0	0.000	0.000	0.000
E. decipiens	2	-0.9231	-0.7645	-0.8825
Tuta absoluta	8	0.8704	0.8191	-0.9266
		Third Sampling Date (20/6/2013)		
No. of hairs		(366)	(577)	(416)
Bemisia tabaci	110	-0.9618	-0.8952	-0.8972
Aphids	0	0.0	0.0	0.0
E. decipiens	0	0.0	0.0	0.0
Tuta absoluta	5	0.2092	0.5378	0.1353

The obtained results are in agreement with those found by Zareh (1987) found significant correlations between infestation by *Empoasca* spp. and the density of hairs and glands on lower surface of cotton leaf. Amr (1993) found that there was a negative correlation between jassid infestation on different cotton varieties and the number of stellate and glandular trichomes in leaf epidermis. Heinz and Zalom (1995) mentioned that tomato cultivars with low trichome (hair) densities sustained less whitefly oviposition. Mohasin et al. (2005) reported that the increase in the number of leaf hair per unit area reduced the population density of *B. tabaci*. Sahu and Shaw (2005) reported that the presence of trichomes on tomato plants had negative effect on whitefly incidence. Also, Samarajeewa et al. (2005) found that tomato plants resistant to infestation with *B. tabaci* had more trichomes on leaves and stems than the susceptible plants. JiRong et al. (2011) reported that the hairy tomato plants can repel aphids, *B. tabaci* and American leaf miner. Snyder and Min (2012) found that tomato accessions resistant to aphids were also resistant to *Liriomyza* sp.

Table 4: The correlation coefficient values for the relationship between the population densities of the examined insect pests and number of hairs on tomato leaflets (cultivar Crystal) during spring-summer plantation of 2013.

Pest	Population density	Average no. of hairs/10 mm^2 at magnification of		
		150X	200X	500X
		First Sampling Date (12/5/2013)		
No. of hairs		(250)	(250)	(150)
Bemisia tabaci	603	-0.9660	-0.9478	-0.9526
Aphids	12	-0.9181	-0.9111	-0.9358
E. decipiens	28	-0.8161	-0.8086	-0.7993
Tuta absoluta	26	0.2055	0.1347	0.1229
		Second Sampling Date (4/6/2013)		
No. of hairs		(500)	(450)	(150)
Bemisia tabaci	226	-0.8980	-0.9662	-0.9091
Aphids	0	0.0	0.0	0.0
E. decipiens	0	0.0	0.0	0.0
Tuta absoluta	0	0.0	0.0	0.0
		Third Sampling Date (20/6/2013)		
No. of hairs		(569)	(399)	(102)
Bemisia tabaci	94	-0.9911	-0.9924	-0.9590
Aphids	0	0.0	0.0	0.0
E. decipiens	0	0.0	0.0	0.0
Tuta absoluta	7	0.2713	0.2669	0.0952

3. Effect of major nutritional components in tomato leaves on the population densities of the considered pests

Data in Tables 5 & 6 reveal that the effect of (N) was positive and highly significant on all considered pests on the cultivars Hybrid Super and Crystal HYB. The effect of (P) was positive and highly significant on all sap sucking pests on the cultivar Crystal, the same relation was found with *T. absoluta* on the cultivar Hybrid. The effect of (K) was negative and highly significant on all considered pests on both cultivars. The effect of (Ca) was positive and highly significant on all considered pests on both cultivars; while (Mg) had positive and highly significant on the investigated pests on the cultivar Hybrid. This element was significantly correlated with sap sucking pests only on the cultivar Crystal.

Table 5: The correlation coefficient values for the relationship between the population densities of the examined insect pests and major nutritional components in tomato leaflets (cultivar Hybrid) during spring-summer plantation of 2013

Sample	*B. tabaci*	N%	"r"	Aphids	N %	"r"	*E. decipiens*	N %	"r"	*Tuta*	N %	"r"
1	1803	3.87		180	3.87		21	3.87		31	3.87	
2	399	3.70	0.8148	0	3.70	0.7119	3	3.70	0.7984	23	3.70	0.9993
3	110	3.25		0	3.25		0	3.25		5	3.25	
	B. tabaci	P%	"r"	Aphids	P %	"r"	*E. decipiens*	P %	"r"	*Tuta*	P %	"r"
1	1803	0.55		180	0.55		21	0.55		31	0.55	
2	399	0.93	0.0524	0	0.93	-0.1076	3	0.93	0.0246	23	0.93	0.5926
3	110	0.29		0	0.29		0	0.29		5	0.29	
	B. tabaci	K%	"r"	Aphids	K %	"r"	*E. decipiens*	K %	"r"	*Tuta*	K %	"r"
1	1803	0.86		180	0.86		21	0.86		31	0.86	
2	399	1.17	-0.7060	0	1.17	-0.5839	3	1.17	-0.6861	23	1.17	-0.9791
3	110	3.69		0	3.69		0	3.69		5	3.69	
	B. tabaci	Ca%	"r"	Aphids	Ca %	"r"	*E. decipiens*	Ca %	"r"	*Tuta*	Ca %	"r"
1	1803	5.22		180	5.22		21	5.22		31	5.22	
2	399	3.36	0.9521	0	3.36	0.8910	3	3.36	0.9432	23	3.36	0.9635
3	110	1.81		0	1.81		0	1.81		5	1.81	
	B. tabaci	Mg%	"r"	Aphids	Mg %	"r"	*E. decipiens*	Mg %	"r"	*Tuta*	Mg %	"r"
1	1803	0.80		180	0.80		21	0.80		31	0.80	
2	399	0.67	0.8846	0	0.67	0.7988	3	0.67	0.8713	23	0.67	0.9953
3	110	0.47		0	0.47		0	0.47		5	0.47	

Table 6: The correlation coefficient values for the relationship between the population densities of the examined insect pests and major nutritional components in tomato leaflets (cultivar Chrystal) during spring-summer plantation of 2013

Sample	*B. tabaci*	N%	"r"	Aphids	N %	"r"	*E. decipiens*	N %	"r"	*Tuta*	N %	"r"
1	1045	4.25		227	4.25		30	4.25		31	4.25	
2	191	4.30	0.5380	0	4.30	0.4576	3	4.30	0.5364	13	4.30	0.8597
3	94	3.38		0	3.38		0	3.38		7	3.38	
	B. tabaci	P%	"r"	Aphids	P %	"r"	*E. decipiens*	P %	"r"	*Tuta*	P %	"r"
1	1045	0.61		227	0.61		30	0.61		31	0.61	
2	191	0.50	0.7792	0	0.50	0.7178	3	0.50	0.7781	13	0.50	0.1343
3	94	0.22		0	0.22		0	0.22		7	0.22	
	B. tabaci	K%	"r"	Aphids	K %	"r"	*E. decipiens*	K %	"r"	*Tuta*	K %	"r"
1	1045	1.24		227	1.24		30	1.24		31	1.24	
2	191	1.43	-0.6292	0	1.43	-0.5544	3	1.43	-0.6277	13	1.43	-0.7619
3	94	3.90		0	3.90		0	3.90		7	3.90	
	B. tabaci	Ca%	"r"	Aphids	Ca %	"r"	*E. decipiens*	Ca %	"r"	*Tuta*	Ca %	"r"
1	1045	4.61		227	4.61		30	4.61		31	4.61	
2	191	3.84	0.8017	0	3.84	0.7429	3	3.84	0.8006	13	3.84	0.9739
3	94	2.17		0	2.17		0	2.17		7	2.17	
	B. tabaci	Mg%	"r"	Aphids	Mg %	"r"	*E. decipiens*	Mg %	"r"	*Tuta*	Mg %	"r"
1	1045	0.62		227	0.62		30	0.62		31	0.62	
2	191	1.07	-0.2863	0	1.07	-0.3738	3	1.07	-0.2881	13	1.07	0.9199
3	94	0.54		0	0.54		0	0.54		7	0.54	

4. Relationship between the minor nutritional components in tomato leaves and population densities of the considered pests

Data in Tables 7 & 8 show the correlation between the percentage of minor nutritional components in tomato leaves sown during summer 2013 and the population densities of the considered tomato pests. These data clearly indicate that the effect of the minor nutrients Fe, Zn and Mn was positive and highly significant on both cultivars and Cu was negatively affected these pests on both cultivars. Again the results of the summer plantation proved to be more reliable in expressing the effect of both major and minor nutrients.

Table 7: The correlation coefficient values for the relationship between the population densities of the examined insect pests and minor nutritional components in tomato leaflets (cultivar Hybrid) during spring-summer plantation of 2013

Sample	***B. tabaci***	**Fe ppm**	**"r"**	**Aphids**	**Fe ppm**	**"r"**	***E. decipiens***	**Fe ppm**	**"r"**	***Tuta***	**Fe ppm**	**"r"**
1	1803	6400		180	6400		21	6400		31	6400	
2	399	2300	0.9491	0	2300	0.9872	3	2300	0.9575	23	2300	0.6197
3	110	3000		0	3000		0	3000		5	3000	
	B. tabaci	Zn ppm	"r"	Aphids	Zn ppm	"r"	*E. decipiens*	Zn ppm	"r"	*Tuta*	Zn ppm	"r"
1	1803	41.75		180	41.75		21	41.75		31	41.75	
2	399	34.50	0.8752	0	34.50	0.7868	3	34.50	0.8615	23	34.50	0.9970
3	110	22.50		0	22.50		0	22.50		5	22.50	
	B. tabaci	Mn ppm	"r"	Aphids	Mn ppm	"r"	*E. decipiens*	Mn ppm	"r"	*Tuta*	Mn ppm	"r"
1	1803	127.25		180	127.25		21	127.25		31	127.25	
2	399	93.00	0.9028	0	93.00	0.8226	3	93.00	0.8905	23	93.00	0.9906
3	110	47.50		0	47.50		0	47.50		5	47.50	
	B. tabaci	Cu ppm	"r"	Aphids	Cu ppm	"r"	*E. decipiens*	Cu ppm	"r"	*Tuta*	Cu ppm	"r"
1	1803	47.50		180	47.50		21	47.50		31	47.50	
2	399	84.25	-0.0085	0	84.25	-0.1680	3	84.25	-0.0363	23	84.25	0.5424
3	110	27.50		0	27.50		0	27.50		5	27.50	

Natarajan (1987) observed that the population of *B. tabaci* escalated as the level of nitrogen increased, but decreased with increased level of potassium with the same level of phosphorus. Rote and Puri (1992) found a highly significant positive correlation between the population of *B. tabaci* and on cotton plants nitrogen content of leaves. Abdallah et al. (2001) found that N and K contents in cotton leaves were negatively correlated with populations of *A. gossypii*, *Empoasca* sp. and *B. tabaci*. They added that all pests' populations were positively correlated with Zn, Fe and Mg content. Leite et al. (2004) reported that N and K contents in tomato leaves had no effect on the egg population of *T. absoluta*. Again Leite et al. (2004) found that N and K contents in tomato leaves had insignificant effect on the population of *B. tabaci*. Hashem et al. (2009) pointed out that the chemical constituents of some solanaceous and cruciferous plant varieties had some effect on the population densities of aphids, leafhoppers and whiteflies. Ashfaq et al. (2012) reported that ferrous (Fe^{2+}) and phosphorous content in tomato leaves were negatively correlated with larval population of *Helicoverpa* *armigera*; whereas nitrogen, calcium, magnesium, manganese and zinc content were positively correlated with larval population. Han et al. (2014) reported that the development time for *T. absoluta* from egg to adult was negatively correlated with tomato leaf N. Hegab et al. (2014) found that the effect of K, P and Ca was insignificant on leafhoppers, aphids and whiteflies infesting eggplant and pepper plants.

In general it could be concluded that the selection of different phenotypes and traits of solanaceous plants is a very fruitful tool in establishing a reliable integrated pest management in clean and organic cultivations. This selection should mainly be based upon the chemical and physical properties of the plant which could act as natural barriers against pest attack. In other words, increased rates of nitrogen and calcium fertilization will increase sap sucking pest populations. On the other hand, increased rates of potassium help the plant to tolerate increased population of the pest.

Table 8: The correlation coefficient values for the relationship between the population densities of the examined insect pests and minor nutritional components in tomato leaflets (cultivar Crystal) during spring-summer plantation of 2013

Sample	***B. tabaci***	**Fe ppm**	**"r"**	**Aphids**	**Fe ppm**	**"r"**	***E. decipiens***	**Fe ppm**	**"r"**	***Tuta***	**Fe ppm**	**"r"**
1	1045	6300		227	6300		30	6300		31	6300	
2	191	5600	0.7943	0	5600	0.7346	3	5600	0.7931	13	5600	0.8760
3	94	4000		0	4000		0	4000		7	4000	
	B. tabaci	Zn ppm	"r"	Aphids	Zn ppm	"r"	*E. decipiens*	Zn ppm	"r"	*Tuta*	Zn ppm	"r"
1	1045	41.25		227	41.25		30	41.25		31	41.25	
2	191	40.75	0.5930	0	40.75	0.5159	3	40.75	0.5915	13	40.75	0.7065
3	94	17.5		0	17.50		0	17.50		7	17.50	
	B. tabaci	Mn ppm	"r"	Aphids	Mn ppm	"r"	*E. decipiens*	Mn ppm	"r"	*Tuta*	Mn ppm	"r"
1	1045	115.25		227	115.25		30	115.25		31	115.25	
2	191	94.50	0.7956	0	94.50	0.7360	3	94.50	0.7944	13	94.50	0.8771
3	94	47.50		0	47.50		0	47.50		7	47.50	
	B. tabaci	Cu ppm	"r"	Aphids	Cu ppm	"r"	*E. decipiens*	Cu ppm	"r"	*Tuta*	Cu ppm	"r"
1	1045	32.50		227	32.5		30	32.5		31	32.50	
2	191	151.73	-0.3850	0	151.73	-0.4689	3	151.73	-0.3868	13	151.73	-0.2430
3	94	27.50		0	27.50		0	27.5		7	27.50	

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تقييم صنفين من الطماطم ضد الإصابة ببعض الآفات الحشرية

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تم إجراء بعض التجارب الحقلية لدراسة التواجد الموسمي وديناميكية المجموع لبعض آفات الطماطم وهي ذبابة الطمام البيضاء *Bemisia tabaci* و نطاط أوراق البطاطس *Empoasca decipiens* وحشرات المنَ (منّ القطن *Aphis gossypii* ومنّ الخوخ الأخضر *Myzus persicae*) بالإضافة لناخرة أوراق الطماطم *Tuta absoluta* ولتقييم حساسية صنفين من الطماطم (Hybrid Super Strain BF_1 and Super Crystal HYB) للإصابة بهذه الآفات كجزء رئيسي من برنامج المكافحة المتكاملة لها والذي يؤدي بالتالي إلى التقليل من استخدام المبيدات في الزراعات النظيفة والعضوية لإنتاج غذاء آمن. تشير النتائج المتحصل عليها إلى أن ذبابة القطن البيضاء كان لها ٢-٣ قمم للتواجد خلال موسمي صيف ٢٠١٢ ، ٢٠١٣ على كلا الصنفين. وكان لكل من المنَ ونطاط الأوراق ١-٢ قمة للتواجد، ومن ناحية أخرى كان لناخرة أوراق الطماطم قمة واحدة للتواجد خلال موسمي الدراسة.

تشير النتائج أيضا إلى وجود علاقة سالبة شديدة المعنوية بين تعداد كل الآفات موضع الدراسة وأعداد الشعرات الموجودة على أوراق نباتات الطماطم والتي كانت معظمها غير غدية. كان تأثير كل من النيتروجين والكالسيوم موجبا وشديد المعنوية بينما كان تأثير البوتاسيوم سالبا وشديد المعنوية على كل الآفات موضع الدراسة. كان تأثير الفوسفور موجبا وشديد المعنوية على الآفات الثاقبة الماصة فقط على الصنف Crystal HYB بينما كان تأثير الماغنسيوم موجبا وشديد المعنوية على كل الآفات على الصنف Hybrid Super. كان تأثير كل من الحديد ، الزنك ، المنجنيز موجبا وشديد المعنوية بينما كان تأثير النحاس سالبا وشديد المعنوية على جميع الآفات موضع الدراسة على كلا الصنفين.